

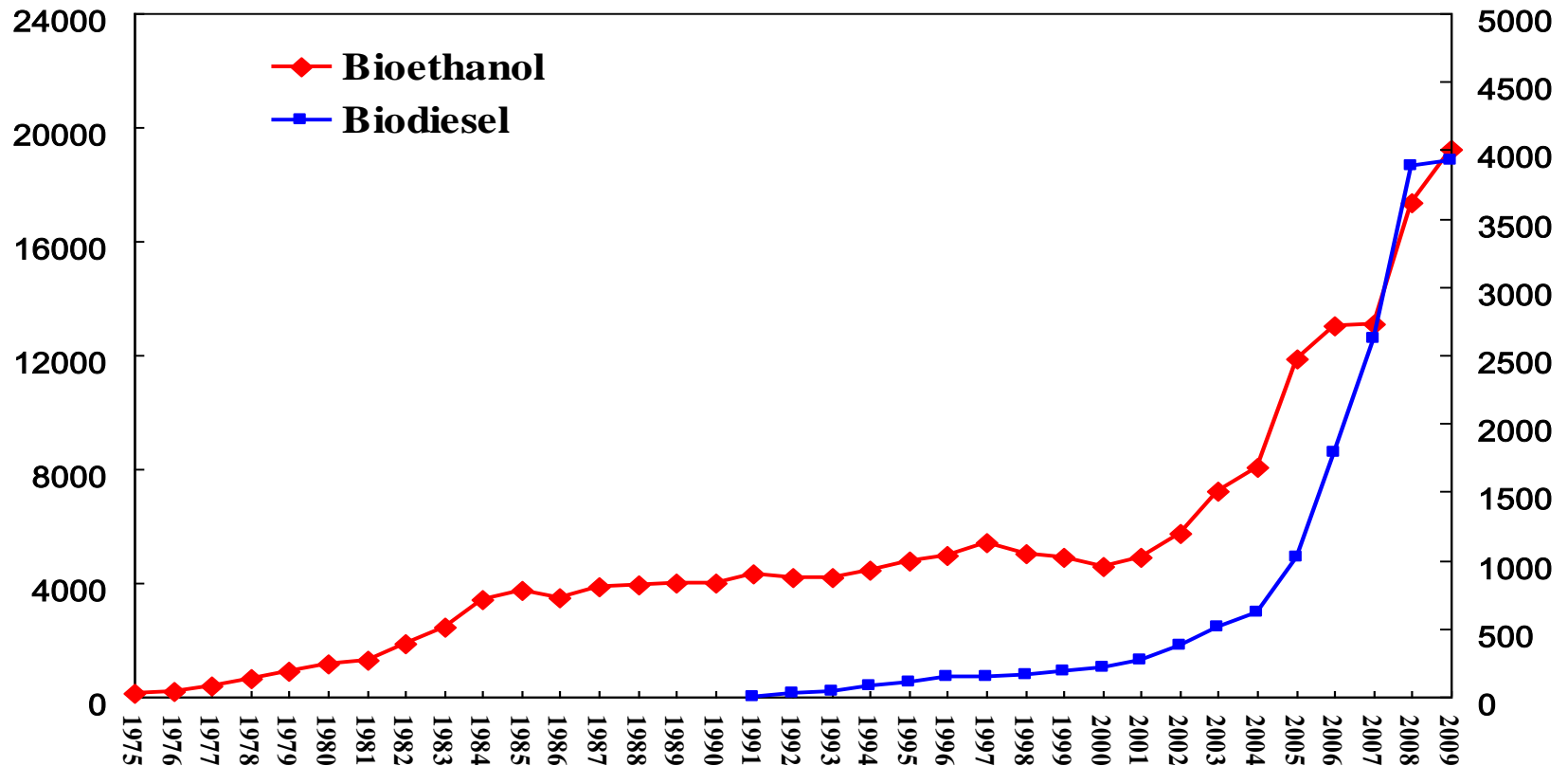


# **Biofuels in the US, Brazil, and the EU and Agriculture in Southeast Asia and China**

**Jikun Huang, Jun Yang, and Huanguang Qiu**  
**CCAP, Chinese Academy of Sciences**

**Scott Rozelle**  
**Stanford University**

# Development of Global Biofuel Production from 1975-2009 ( million gallons )



Data source : F.O. Licht ( 2010 )

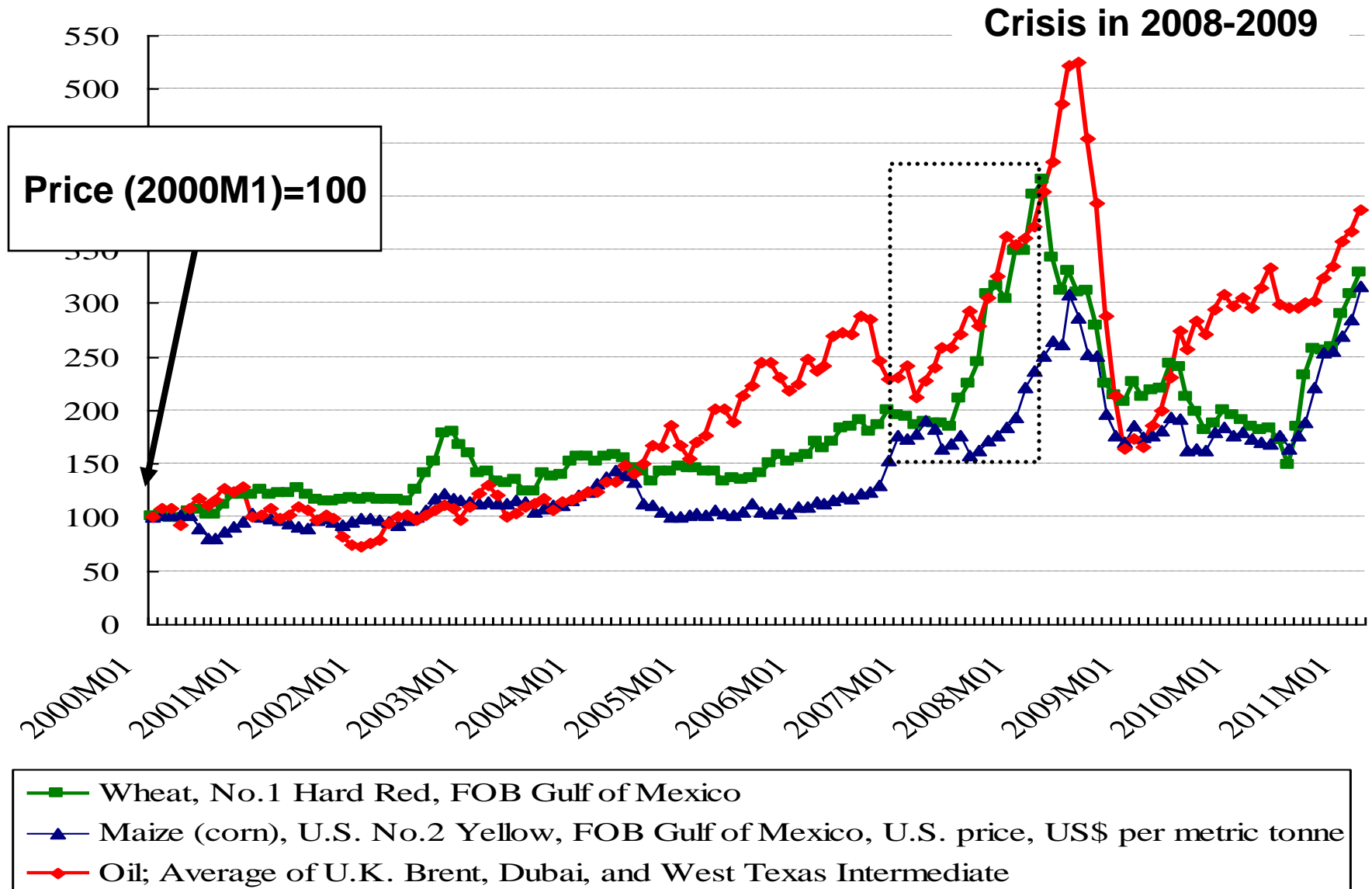
During 1990-2000, ethanol growth is **14%** in total

During 2001-2008, ethanol production rises by **251%** (average annual growth rate **20%**)

diesel production increase **649%** (average annual growth rate **33%**)

In 2009, the global bio-ethanol rises by 10%, with the biodiesel almost constant...

# Effects of biofuel development are still there...Like crouching tighter...



# So what are the exact global impacts?

- **Goal of the rest of this talk is to try to chart the *Global Impact Pathways* of biofuels.**
  - ***Specific objective 1: create a modeling platform to analyze the impacts***
  - ***Specific objective 2: examine impact of rise of biofuels from key countries in the world on different regions (focus on Southeast and China)***

# Organization of the Presentation

- **Global Pathway:**
  - The modeling approach (GTAP+CAPSiM) and data (not presented due to time limitation)
- **Scenarios**
- **Results:**
  - World price and trade (US, Brazil, and EU)
  - Southeast Asia and other regions
  - China
- **Conclusion Remarks**

# Modified GTAP-E model + CAPSiM and data

## Model

- Creating ethanol and diesel industry in the model
- More detail agricultural commodities
  - Separating maize from coarse grain
  - Separating soybean from oilseeds
- Adding the module to reflect the substitution between biofuel and gasoline
- Multi-inputs and multi-output production
- Taking into the by products of Biofuel (DDGs)
- Considering Different Land mobility among crops

## Data

- Input/output
- Biofuel and trade policies
- Behavioral parameters

# Scenarios:

## 1. Reference scenario

- Biofuels production in all countries in the world are kept at their 2006 level (in other words, we are simulating the effect of a world-wide ban of not allowing any expansion over what was already in place)

## 2. Two Key Alternative Scenarios

- **Market Scenario:** In the market scenario, governments do not intervene into the production decisions of biofuels producers ... Biofuels production is carried out purely on the basis of [international energy prices](#)
- **Policy Intervention Scenario:** In the policy intervention scenario, governments intervene into the production decisions of biofuels producers by offering subsidies (which are equivalent to those actually being considered as of 2008) to reach their production [targets](#)...



# Targets of Biofuel Production in 2020 of Selected Countries

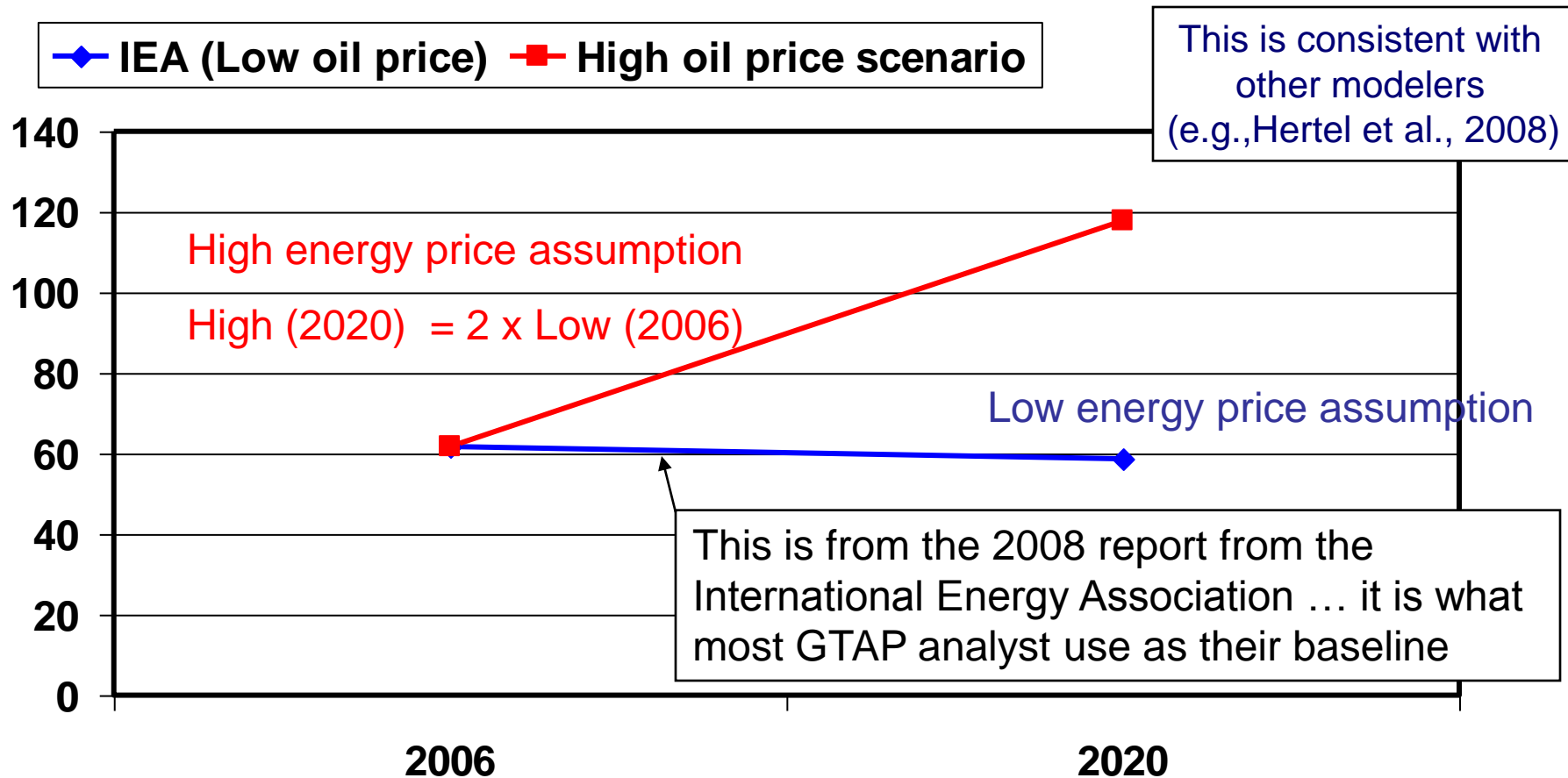
---

	<b>2006</b>	<b>Target in 2020</b>	<b>+ Increased (%)</b>
<b>Ethanol (million tons)</b>			
USA	<b>15.9</b>	<b>49.1</b>	<b>+209</b>
EU	<b>1.5</b>	<b>21.0</b>	<b>+1300</b>
Brazil	<b>14.7</b>	<b>43.2</b>	<b>+194</b>
<b>Diesel (million tons)</b>			
USA	<b>0.8</b>	<b>6.9</b>	<b>+763</b>
EU	<b>4.9</b>	<b>46.4</b>	<b>+847</b>

---

Source: Yang et al., 2009

# Sensitive analysis on crude oil prices (US dollars per barrel) in 2006-2020



# Sensitive analysis on elasticities of substitution between gasoline and biofuel

- **Low elasticity: 3**

This is about the same level as used in the analyses by Hertel et al. (2-4) and the LEI Banse et al. (5)

This (“3”) means that when the price of gasoline goes up, there is little impetus to substitute into ethanol

- **High elasticity: 10**

This (“10”) means that when the price of gasoline goes up, there is a lot of impetus to substitute into ethanol [note: “infinity” is perfect substitution]

# Analytical plan (to help understand what really matters)

## Low Energy Price Projections

Low Elast. of  
Substitution:  
Gas and Ethanol

High Elast. of  
Substitution:  
Gas and Ethanol

## High Energy Price Projections

Low Elast. of  
Substitution:  
Gas and Ethanol

High Elast. of  
Substitution:  
Gas and Ethanol

**Reference  
Scenario**

**Market  
Scenario**

**Policy  
Intervention  
Scenario**

Notes:

Low Energy Price from IEA;

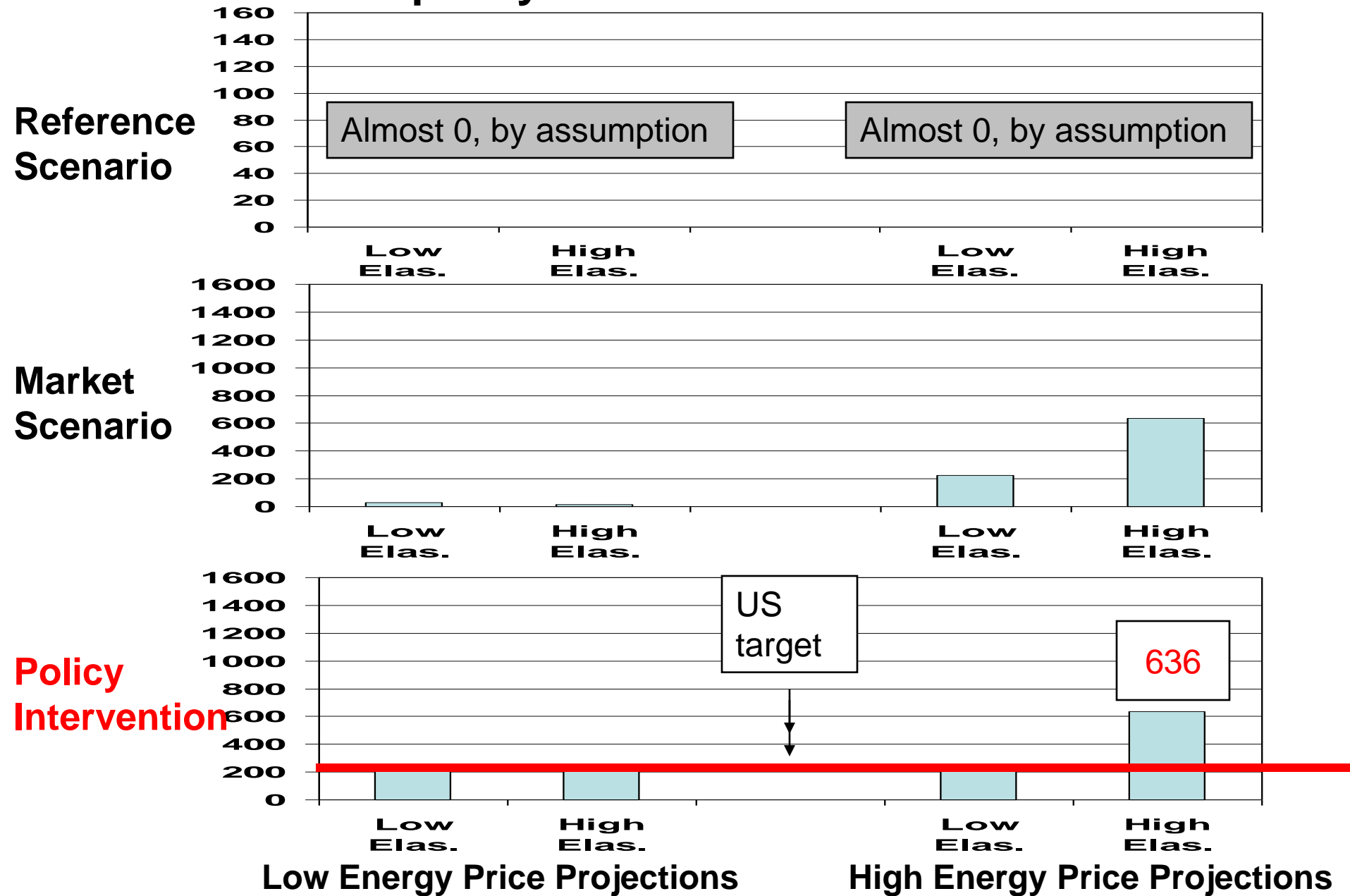
High Energy Price = (2 x Low Energy Price)

Low Elast. of Sub., Gas and Ethanol = 3; High Elasticity = 10

# **Scenario Results:**

Price, Production and Trade

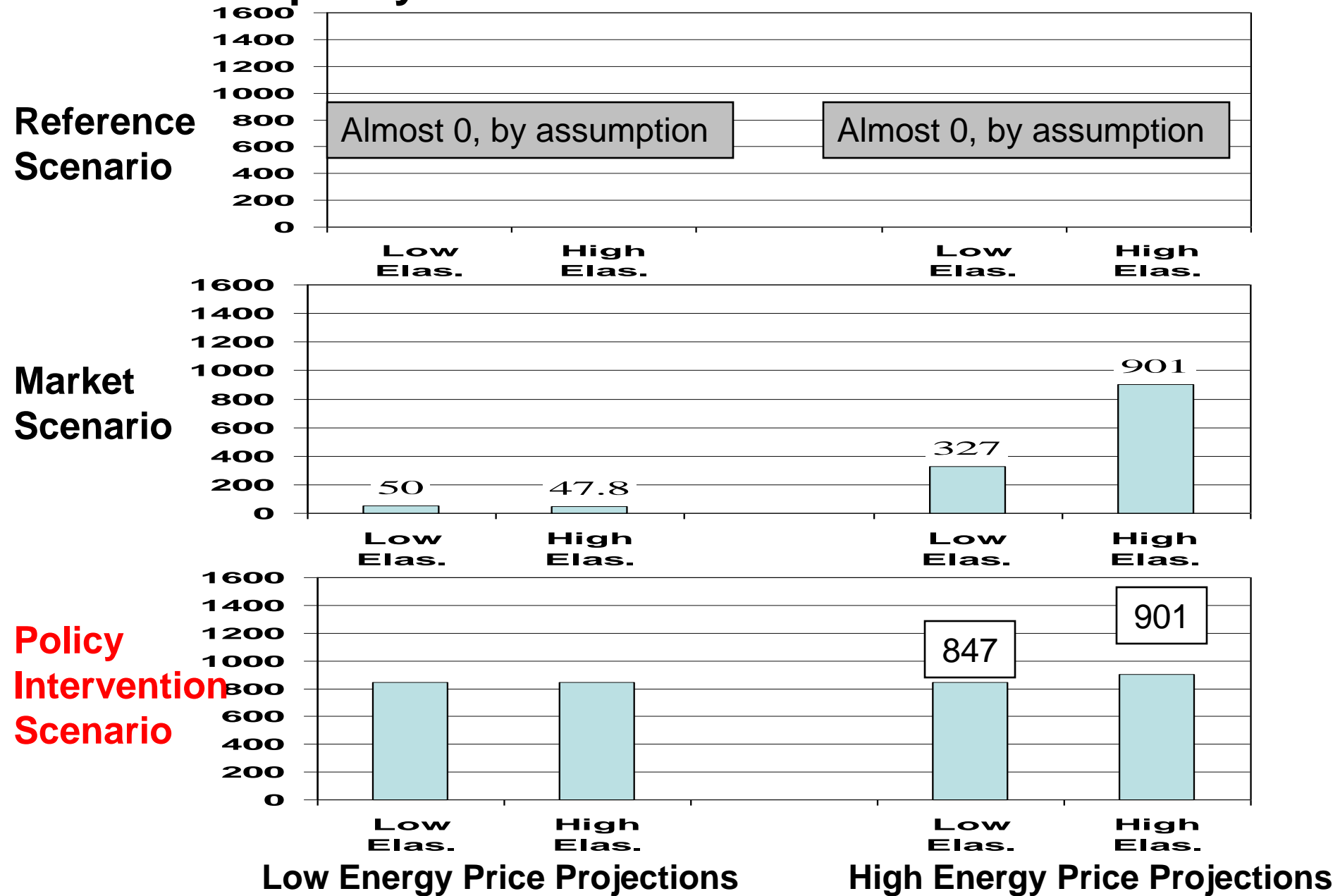
# Ethanol production (% change) in 2020 over 2006 under market and policy intervention scenarios in USA



# Observations on US biofuels production

- Production changes at low energy prices / no policy intervention: nearly 0
- There is some biofuels produced at high energy prices ... the substitution of ethanol and gasoline REALLY MATTERS ...
- US policy really matters (determines biofuels production ... except in a world with high energy prices / and a fleet of cars in which ethanol is a close substitute for gasoline) ...
- High price / high substitutability: Only energy prices matter ... biofuels is NOT being driven by government policy ...

# Diesel production (%) in 2020 over 2006 under market and policy intervention scenario in EU27





# Maize prices, production and exports in US under assumptions of oil price and elas. of substitution (comparing to reference, 2020)

	Market		Policy intervention	
	Low Price	High Price	Low Price	High Price
<b>Price</b>				
High subst.	0.7	49.6	15.0	49.6
Low subst.	1.4	12.8	15.0	13.9
<b>Production</b>				
High subst.	1.0	54.0	17.0	54.0
Low subst.	2.1	19.8	17.0	18.6
<b>Export</b>				
High subst.	1.2	-24.5	-16.6	-24.5
Low subst.	-0.3	-8.0	-16.6	-16.4

# **Soybean prices, production and exports in US** under assumptions of oil price and elas. of substitution (comparing to reference,2020)

	Market		Policy intervention	
	Low Price	High Price	Low Price	High Price
<b>Price</b>				
High subst.	0.4	24.2	12.5	24.2
Low subst.	0.7	6.7	12.5	11.7
<b>Production</b>				
High subst.	0.0	5.7	8.5	5.7
Low subst.	0.3	2.8	8.5	8.7
<b>Export</b>				
High subst.	0.7	-14.5	-13.3	-14.5
Low subst.	0.1	-3.9	-13.3	-13.3

# **Rapeseeds** prices, production and exports in **EU** under various assumptions of oil price and elas. of substitution (comparing to reference,2020)

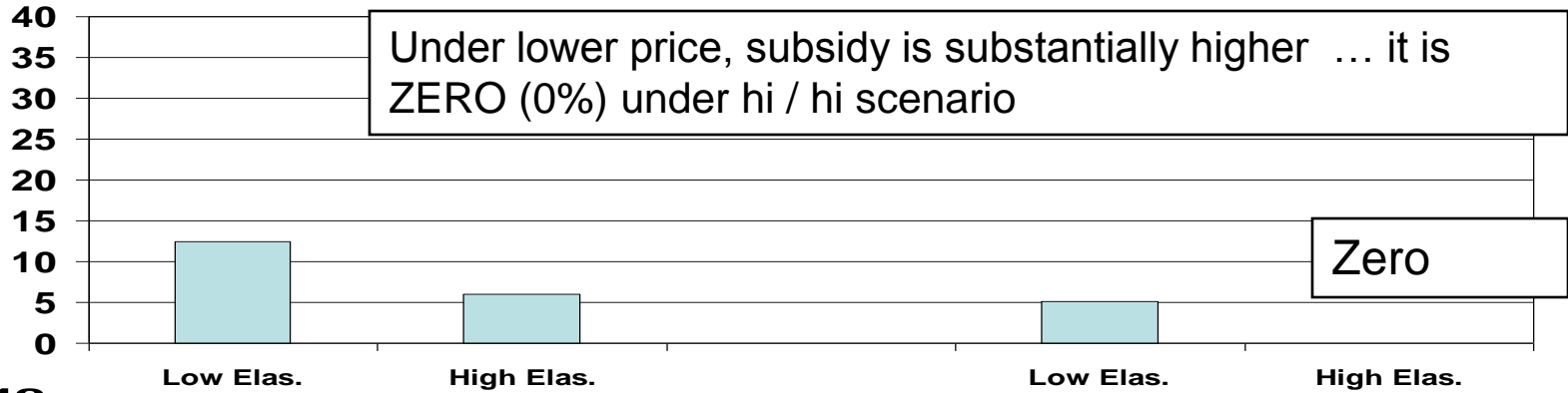
	Market		Policy intervention	
	Low Price	High Price	Low Price	High Price
<b>Price</b>				
High subst.	1.2	<b>36.8</b>	33.0	<b>36.8</b>
Low subst.	1.4	10.9	33.0	30.5
<b>Output</b>				
High subst.	3.9	89.4	81.6	89.4
Low subst.	4.5	35.7	81.6	84.6
<b>Export</b>				
High subst.	-4.9	-61.3	-62.8	-61.3
Low subst.	-5.3	-32.1	-62.9	-62.3

# **Sugarcane** prices, production and exports in **Brazil** under various assumptions of oil price and elas. of substitution (comparing to reference,2020)

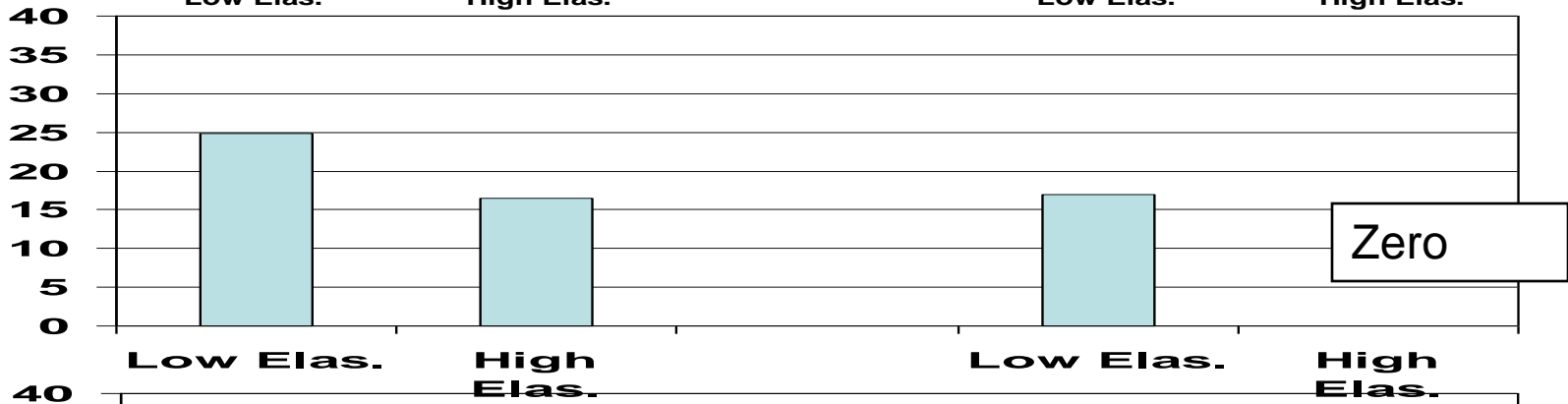
	Market		Policy intervention	
	Low Price	High Price	Low Price	High Price
<b>Price</b>				
High subst.	6.5	<b>89.3</b>	50.6	<b>89.3</b>
Low subst.	9.1	43.6	50.6	45.7
<b>Output</b>				
High subst.	16.3	<b>148.8</b>	94.1	<b>148.8</b>
Low subst.	22.6	100.1	94.3	99.1
<b>Export</b>				
High subst.	-28.7	-94.3	-87.5	-94.3
Low subst.	-36.4	-82.4	-87.5	-85.3

# Government subsidy (billion US\$) in 2020 under policy intervention scenario

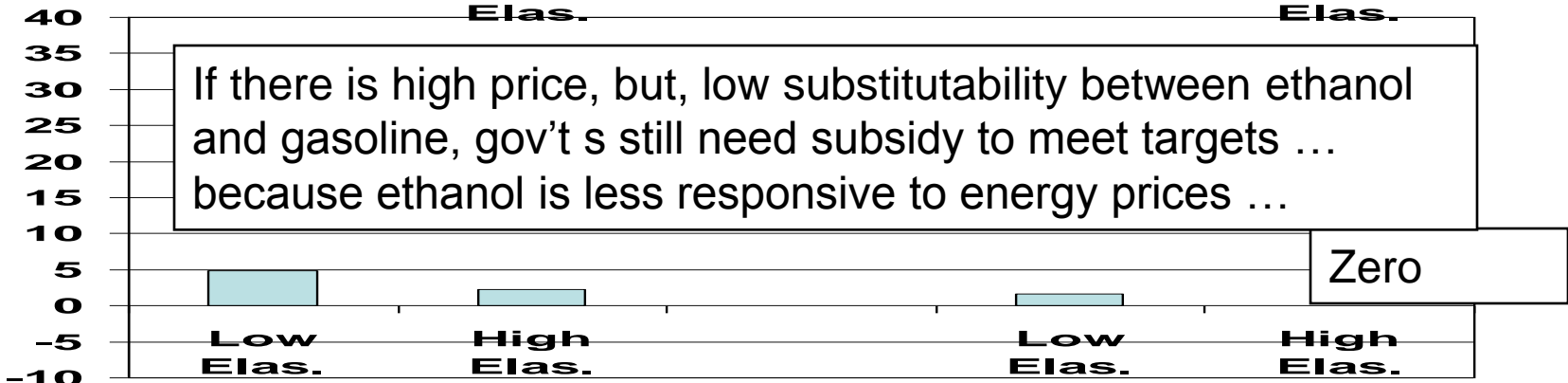
USA



EU



Brazil



Low Energy Price Projections

High Energy Price Projections

# Generalizations – impacts of biofuels on key/developed countries that are major agricultural producers

- Biofuels matter ...
  - Biofuels policy matters (quite a bit) ... [in a lo / lo world, biofuels would not expand without policy]
  - **But**, if ethanol and gasoline are highly substitutes, high energy prices will drive biofuels development ...
- High price / high substitutability: If the government want to control, the only choice is banning biofuel production...

# Results: Southeast Asia and Other Developing Countries

- East Africa
- West Africa
- South Africa
- India
- **Southeast Asia**

# Impacts on the price, production, export and self-sufficiency of selected developing countries in HH scenarios (comparing to reference, 2020)

	East Africa	West Africa	South Africa	India	<b>Southeast Asia</b>
<b>Maize</b>					
Price	8.5	7.8	10.3	13.8	<b>15.6</b>
Production	6.1	5.4	3.6	2.0	<b>8.1</b>
Export	235.1	273.7	43.5	101.6	<b>160.1</b>
Self-sufficiency	5.0	2.1	4.5	2.8	<b>5.9</b>
<b>Wheat</b>					
Price	5.1	5.2	5.4	6.7	<b>6.3</b>
Production	2.2	4.2	0.3	0.0	<b>0.0</b>
Export	13.7	15.2	5.2	1.0	<b>5.3</b>
Self-sufficiency	0.7	1.0	0.4	0.7	<b>0.1</b>

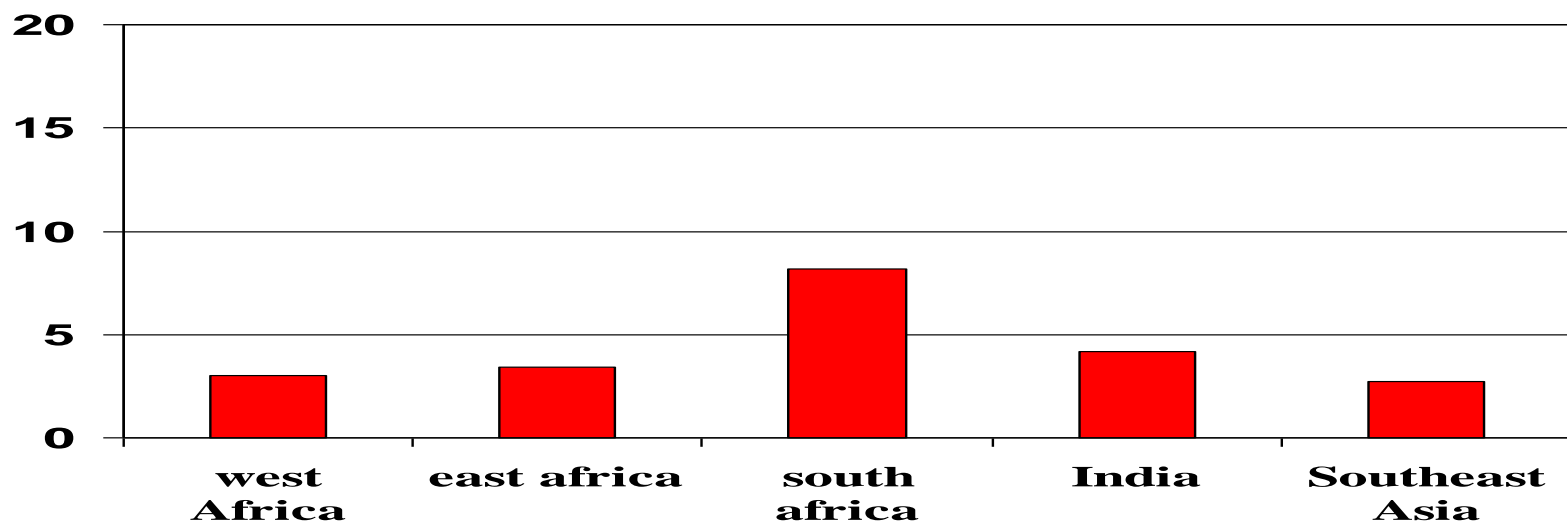
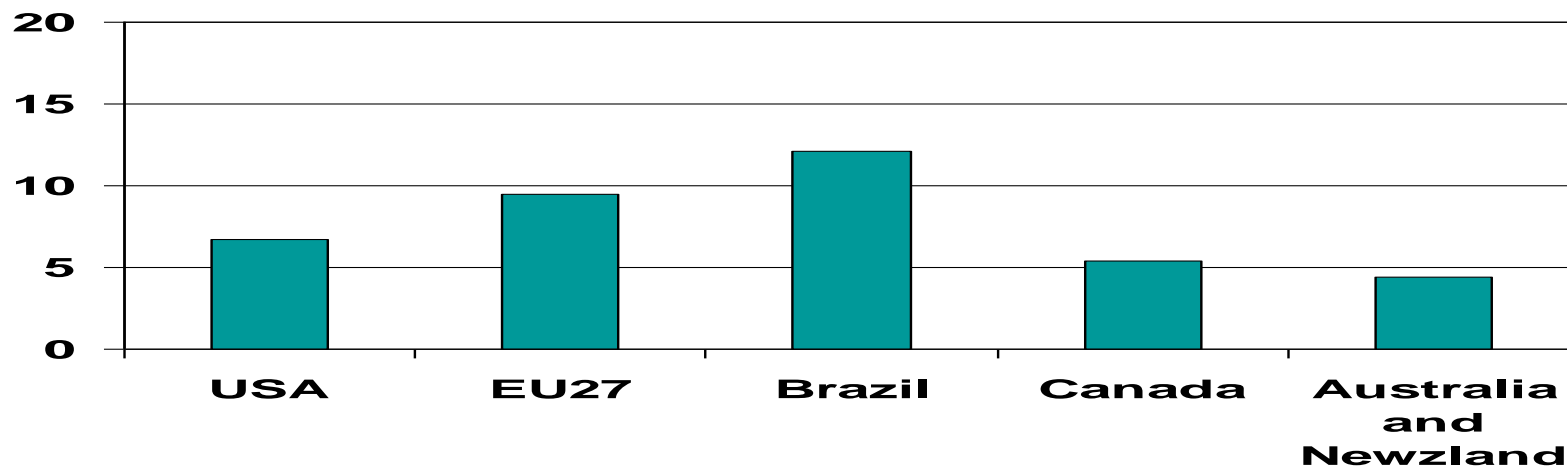


# Impacts on the price, production, export and self-sufficiency of selected developing countries in HH scenarios (comparing to reference, 2020)

	East Africa	West Africa	South Africa	India	Southeast Asia
<b>Rice</b>					
Price	3.0	3.8	8.7	10.6	<b>4.6</b>
Production	-0.2	-1.3	-3.4	-0.2	<b>-0.8</b>
Export	20.2	18.6	-12.1	-34.8	<b>1.0</b>
Self-sufficiency	0.0	1.1	-1.6	-0.1	<b>0.0</b>
<b>Beef &amp; Mutton</b>					
Price	1.0	1.2	1.7	5.7	<b>2.6</b>
Production	-0.1	-1.5	1.3	-2.1	<b>0.4</b>
Export	16.5	13.7	12.1	-12.5	<b>4.1</b>
Self-sufficiency	0.5	0.5	1.4	-3.0	<b>0.2</b>

# **Impacts on farmer's income**

# Impact of rise of biofuels on Farmer's wage (unskilled labor) in 2020 under HH Scenario (comparing to RS, %)



**Impacts on agr. value-add and return to primary factors in  
agri. sectors in selected developed countries in HH Scenarios**  
(comparing to reference, 2020)

---

	<b>USA</b>	<b>EU27</b>	<b>Brazil</b>	<b>Canada</b>	<b>Australia and New Zealand</b>
<b>Value-added</b>	14.2	11.3	17.4	11.5	6.7
Unskilled Labor	6.7	9.5	12.1	5.4	4.4
Skilled labor	4.8	6.0	3.9	4.3	3.4
Capital	6.6	4.8	10.2	4.4	2.8
Land	65.4	60.9	67.3	60.1	17.3

---

**Impacts on agri. value-add and return to primary factors in agri. sectors in selected developing countries in HH Scenarios**  
 (comparing to reference, 2020)

	East Africa	West Africa	South Africa	India	Southeast Asia
<b>Value-added</b>	4.8	4.3	12.8	11.2	<b>4.4</b>
Unskilled Labor	3.0	3.4	8.2	4.2	<b>2.7</b>
Skilled labor	1.4	2.3	4.1	0.6	<b>1.6</b>
Capital	2.1	3.0	5.3	3.3	<b>2.4</b>
Land	5.6	5.9	29.7	16.2	<b>10.2</b>

# Generalizations:

## Southeast Asia and other regions (I)

- If energy prices stay high ...  
or policy scenario (with lower energy prices),  
agricultural prices are going to rise in developing  
countries
- For agriculture, this could be an **opportunity...**  
Increasing demands by biofuel sectors definitely  
opportunity for agriculture...How to reap the benefit  
and offset its adverse effects should be considered  
by individual countries and global society.

# Generalizations:

## Southeast Asia and other regions (II)

- Good news for producers ... bad news for consumers...
- The getting-close relationship between oil (petroleum) price and agricultural price makes the agricultural price more fluctuant than before... this has implications to food security term of price...

# Results: China

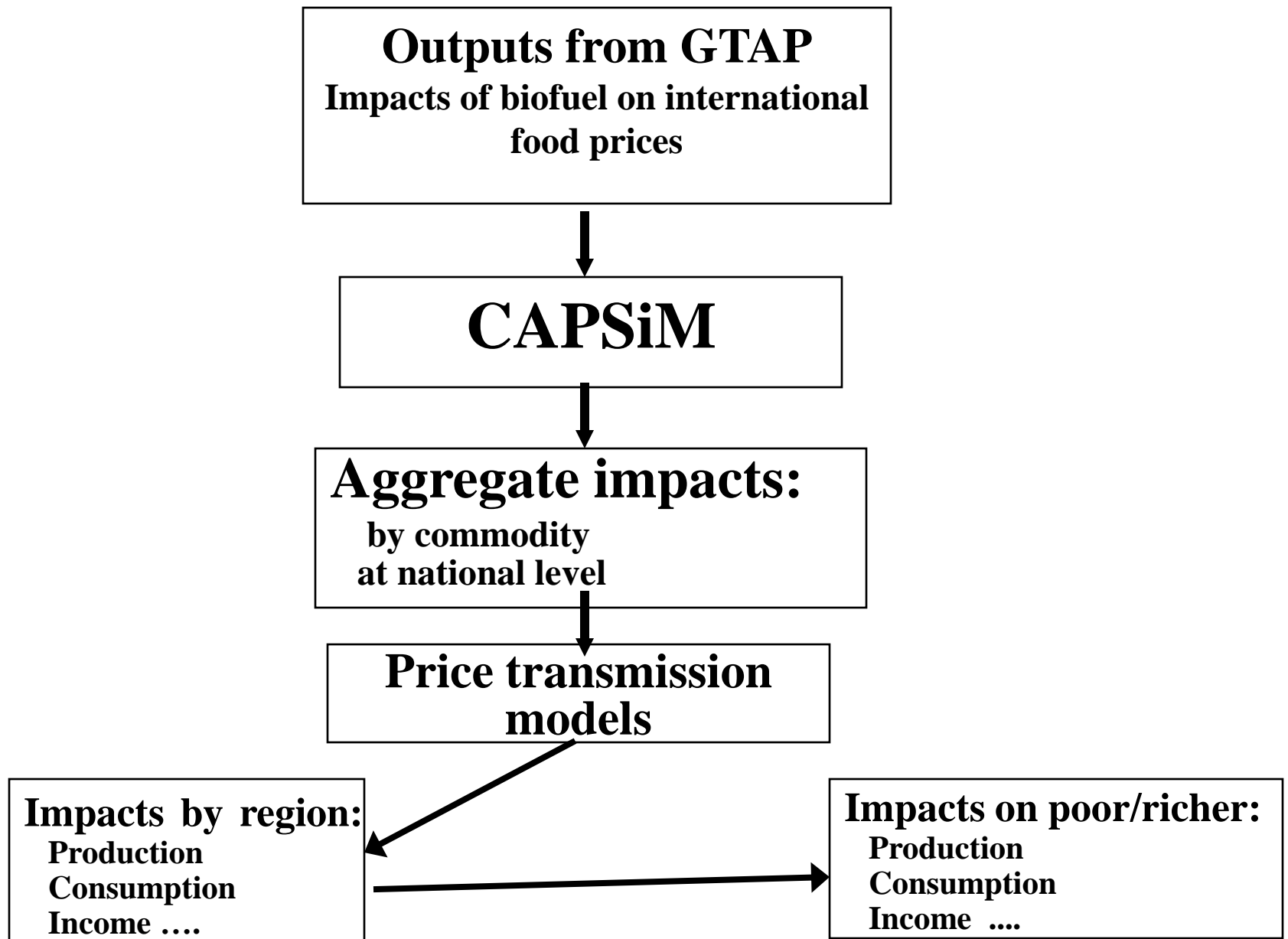
Methodology

**Results**



# Methodologies

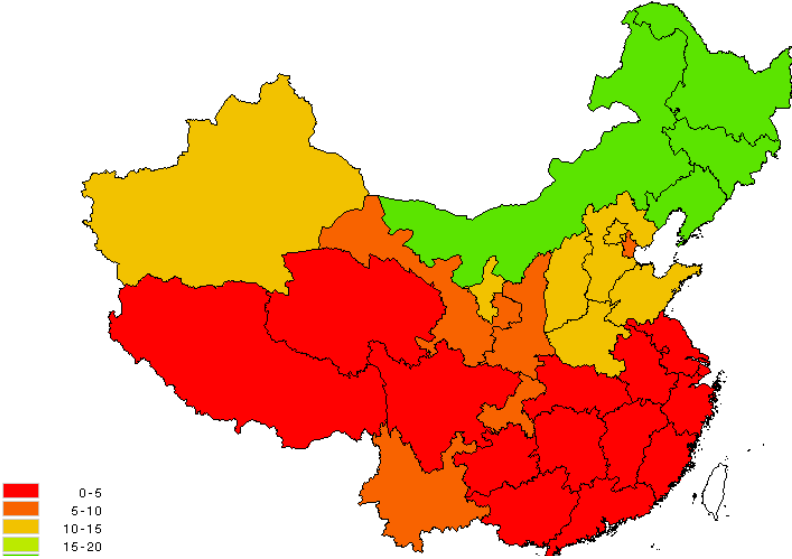
- **GTAP (Global Trade Analysis Program)**
  - **Simulate the world price changes**
- **China's Agricultural Policy Simulation and Projection Model (CAPSiM)**
  - **Partial equilibrium model**
  - **Commodities:**
    - 12 crops or crop groups**
    - 7 livestock and aquatic products**
    - 31 provinces**
    - 11 farmer groups per region (10 group+1 average)**



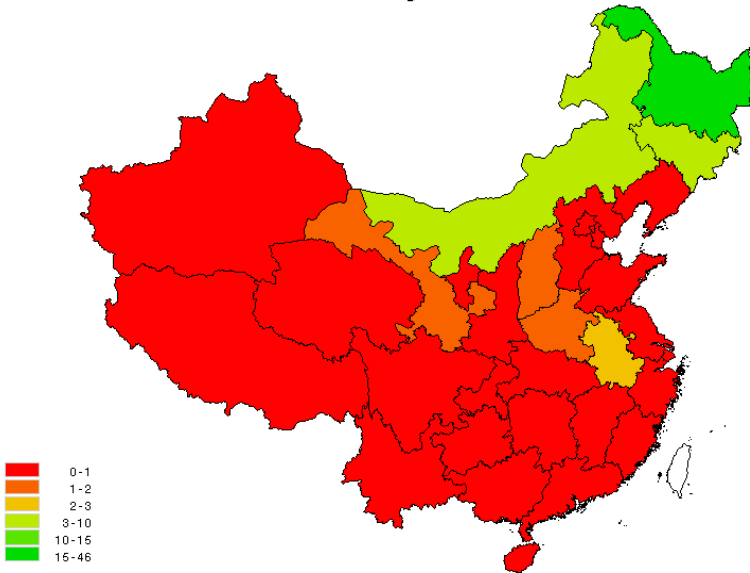
**A framework for regional model and policy interventions analysis**

# Impacts on production of diff. commodities in diff. provinces under mandate scenario (kg/ household, 2020)

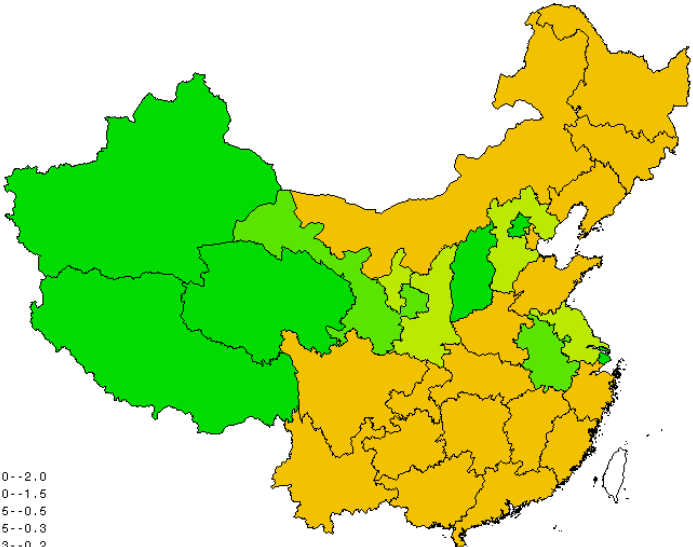
Maize



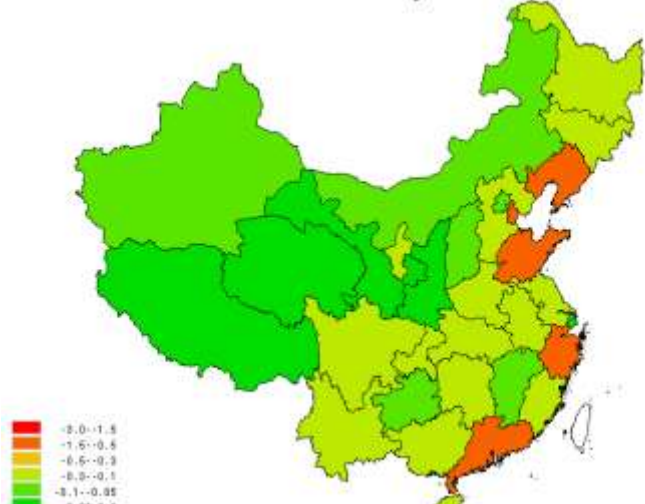
Soybean



Pork

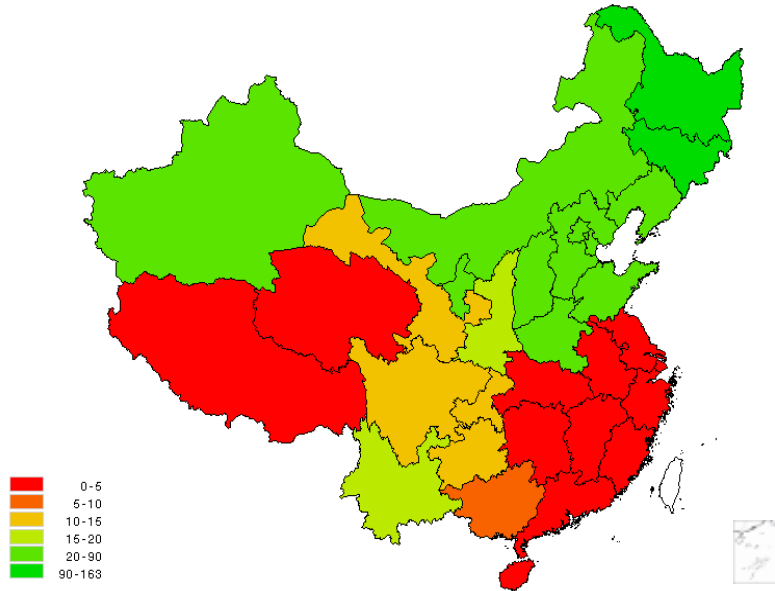


Poultry

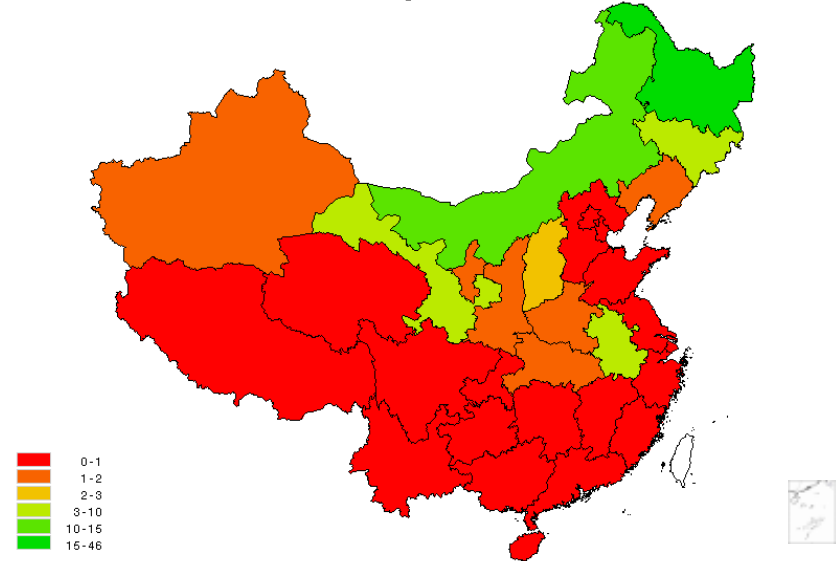


# Impacts on production of diff. commodities in diff. provinces under H-H scenario (kg/ household, 2020)

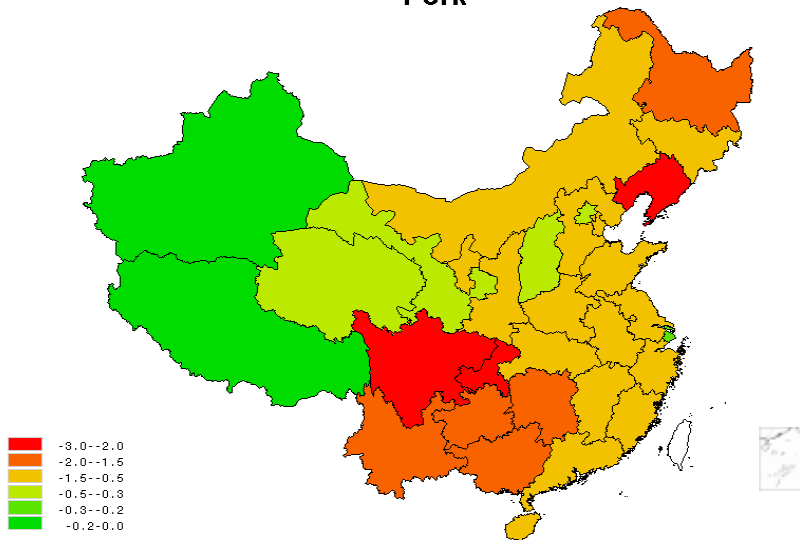
Maize



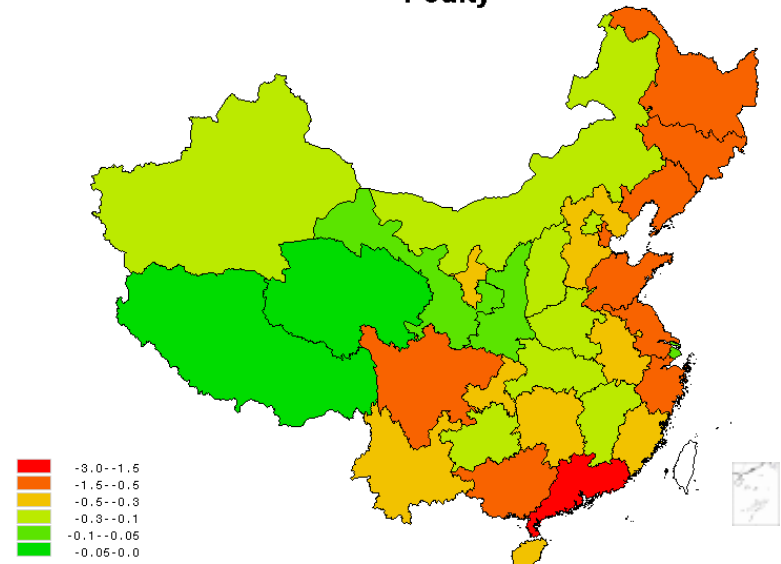
Soybean



Pork

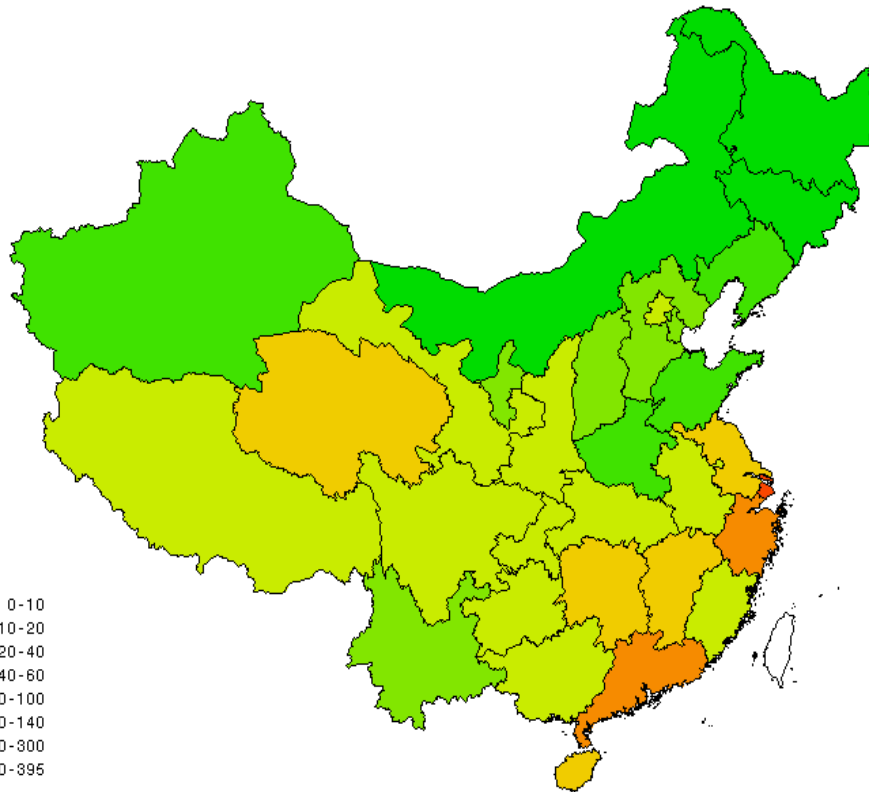


Poultry

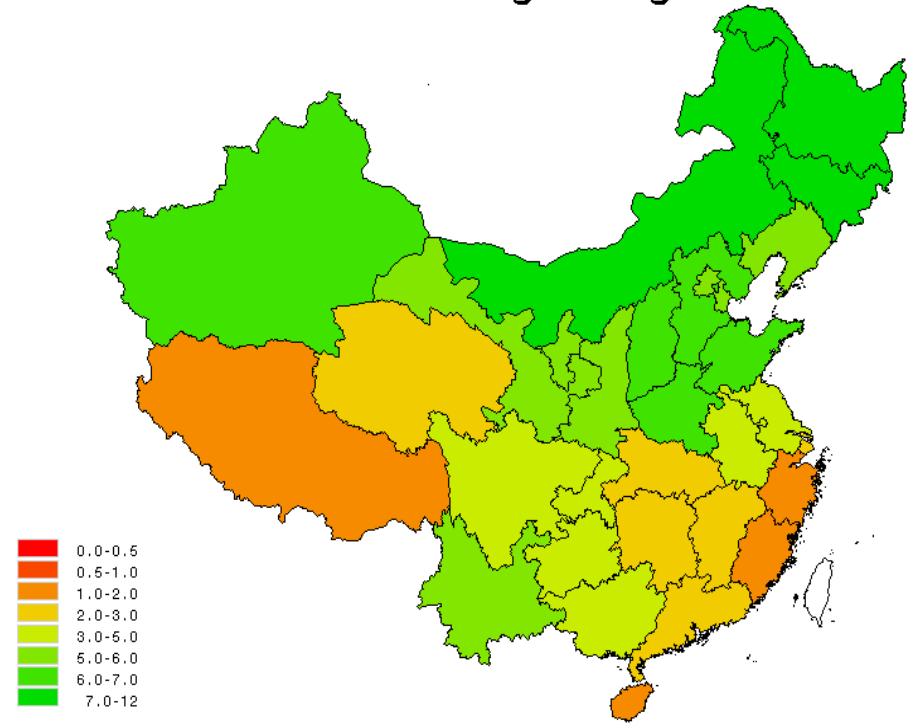


# Impacts of biofuel development on Chinese farmers' agricultural income by different provinces in 2020 under H-H scenario

Yuan/household



Percentage Change



# **Concluding Remarks**

**Energy price and national biofuel policies in in US, EU and Brazil will significantly affected global food price, production & trade**

**Biofuel development will also raise food prices and production in Southeast Asia and China, but vary among sectors...**

- Production of feedstock crops (maize, soybean, other oilseeds, sugar) will expand...
- Production of other crops and livestock will decline...

**Extend of impacts highly depends on energy price and substitution of gasoline and biofuels**

**Good news for producers, including farmers in Southeast Asia and China...**

**Bad news for consumers... and national food price stability policy...**

**If the government in Southeast Asia and China concerns on the rising agricultural price, the best choice is increasing the agricultural productivity...**